UCRL-ID-146031

KDP Impurity Data

R. A. Torres

October 25, 2001

U.S. Department of Energy

Lawrence
Livermore
National
Laboratory

DISCLAIMER

This work was performed under the auspices of the U. S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under Contract No. W-7405-Eng-48.

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UCRL-ID-146031

October 22, 2001

Dr. Ronald J. Rusay
Department of Chemistry
Diablo Valley College
321 Golf Club Road
Pleasant Hill, CA 94523

Dear Ron:

Attached are the impurity data for 20-liter growth runs N. Zaitseva / L. Carman made in the 1996-1997 time frame for which we have both solution and crystal data. The 5 impurities added for the runs are Al(III), Cr(III), Fe(III), Mo(VI), and Sb(V).

As an explanation of the tables, I report all impurity concentrations as ppb (ng/g_{KDP}) with respect to dry KDP (even solution data.) "MDL" stands for "Method Detection Limit." Nominal uncertainties are 1 MDL or 10% of the quoted value, whichever is greater. If the measured value is less than the MDL, I report "ND," for "Not Detected." If the value is greater than the MDL, but less than twice the MDL, I report "D," for "Detected." If the value is more than twice the MDL, I report two significant figures.

The values come from ICP-ES and ICP-MS measurements. I give the detection limit for the more sensitive technique in the table under the "MDL" heading. In cases where only one technique was used, I give the MDL for that technique in parentheses after the impurity value in the table. Since these measurements were made, changes in instrumentation have resulted in significant improvements in many of the detection limits.

Unfortunately, we no longer have any of the KDP boules from this time period. We now are concentrating on deuterated KDP, which we cannot send to you. I also am not able to locate any database of absorption spectra, which correspond to the impurity measurements for the attached data.

Sincerely,

Richard A Torres

Richard A. Torres

Attachments

University of California
Lawrence Livermore
National Laboratory

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R. A. Torres
ICP-ES / ICP-MS*
Updated: 08-27-97

ng/gKDP		#5-1	#6-1	#131-seed-6	#131-seed-7	#131-seed-9	#131-2-8	#131-2-9	#131-2-11	#131-2-13
Z	MDL	before #131	after #131			edge			edge	
		4/14/96	4/22/96	12/27/96	12/27/96	12/27/96	12/27/96	1/13/97	12/27/96	1/13/97
		KDP	KDP	KDP	KDP	KDP	KDP	KDP	KDP	KDP
B	1000	13000	26000	ND	ND	ND	ND	ND	ND	ND
Na	300	81000	150000	D	D	D	D	D	D	D
Mg	5	88	160	ND	ND	ND	ND	ND	12	D
Al	100	2800	640	17000	18000	5100	12000	15000	D	7300
Si	100	7700	25000	310	310	410	350	290	D	220
Cr*	100	ND	ND	580	620	D	390	530	ND	270
Mn*	100	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fe	50	400	140	2100	2100	750	1700	1800	ND	880
Rb*	100	9400	16000	1200	1100	1500	1200	1200	1200	1200
Sr	5	320	110	2000	1800	390	870	1400	510	970
Zr*	100	ND	ND	220	220	D	220	D	ND	ND
Mo	100	ND	ND	ND	ND	D	ND	ND	ND	ND
Sb*	100	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ba	5	52	ND	890	600	16	120	480	270	470

MDL= Method Detection Limit
D= Detected
ND= Not Detected

ng/gKDP		#131-2-15	#131-tip-ave	#131-seed-12	#131-seed-14	#131-cap-2	#131-cap-3
Z	MDL	edge					
		1/13/97	1/6/97	7/23/97	7/23/97	8/6/97	8/6/97
		KDP	KDP	KDP	KDP	KDP	KDP
B	1000	ND	ND	ND	ND	ND	ND
Na	300	D	D	D	D	460	D
Mg	5	ND	ND	ND	D	ND	ND
Al	100	6300	290	19000	5100	260	D
Si	100	460	220	370	440	310	290
Cr*	100	D	ND	<500	<500	<500	<500
Mn*	100	ND	ND	<50	<50	<50	<50
Fe	50	920	ND	2000	620	ND	ND
Rb*	100	1300	2000				
Sr	5	430	100	1700	400	71	210
Zr*	100	250	ND				
Mo	100	D	ND	ND	ND	ND	ND
Sb*	100	ND	ND	<200	<200	<200	<200
Ba	5	23	ND	560	15	D	10

MDL= Method Detection Limit
D= Detected
ND= Not Detected

ng/gKDP		#25-1	#26-1	#181-seed-6	#181-seed-7	#181-seed-10	#181-1-10	#181-3-6	#181-3-7	#181-3-10
Z	MDL	before #181	after #181	prism(early)	prism	prism(edge)		pyramid(early)		prism(late)
		9/19/96	10/2/96	1/31/97	1/31/97	1/31/97	1/31/97	1/31/97	1/31/97	1/31/97
		KDP	KDP	KDP	KDP	KDP	KDP	KDP	KDP	KDP
B	1000	18000	35000	ND	ND	ND	ND	ND	D	2200
Na	300	86000	170000	ND	ND	ND	D	ND	ND	ND
Mg	5	97	200	ND	ND	ND	14	ND	ND	ND
Al	100	250	D	4100	4100	1300	1300	ND	ND	1300
Si	100	9000	49000	320	310	500	600	ND	ND	640
Cr*	100	2000	240	11000	12000	3300	2800	490	700	3100
Mn*	100	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fe	50	440	D	2200	1800	1000	940	ND	ND	990
Rb*	100	9500	18000	980	1000	1200	1300	1000	1200	1300
Sr	5	300	100	1900	1800	310	330	450	380	320
Zr*	100	ND	ND	240	300	240	D	ND	ND	240
Mo	100	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sb*	100	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ba	5	100	30	1600	1200	24	60	370	220	31

MDL= Method Detection Limit
D= Detected
ND= Not Detected

ng/gKDP		#181-tip	#181-seed-11	#181-seed-12	#181-cap-1	#181-cap-3-av
Z	MDL	pyramid(late)			KDP	KDP
		1/31/97	7/23/97	7/23/97	8/6/97	8/6/97
		KDP	KDP	KDP	KDP	KDP
B	1000	ND	ND	ND	ND	ND
Na	300	ND	D	D	D	D
Mg	5	18	ND	ND	ND	D
Al	100	ND	5600	1900	ND	D
Si	100	D	500	770	320	330
Cr*	100	850	12000(500)	2900(500)	D (500)	D (500)
Mn*	100	ND	<50	<50	<50	<50
Fe	50	ND	2000	1000	ND	ND
Rb*	100	1800				
Sr	5	62	2200	340	86	91
Zr*	100	D				
Mo	100	ND	ND	ND	ND	ND
Sb*	100	ND	<200	<200	<200	<200
Ba	5	D	1800	27	15	15

MDL= Method Detection Limit
D= Detected
ND= Not Detected

R. A. Torres
ICP-ES / ICP-MS*
Updated: 01-28-98

ng/gKDP		#4-2	#5-2	#147-seed-7	#147-seed-9	#147-3-8	#147-3-11	#147-tip-ave	#147-seed-10	#147-seed-12
Z	MDL	before #147	after #147							
		5/31/96	6/10/96	12/13/96	12/13/96	12/13/96	12/13/96	12/13/96	7/30/97	7/23/97
		KDP	KDP	KDP	KDP	KDP	KDP	KDP	KDP	KDP
B	1000	11000	22000	ND	ND	ND	ND	ND	ND	ND
Na	300	69000	110000	ND	ND	ND	ND	ND	760	ND
Mg	5	75	130	ND	ND	ND	D	ND	D	ND
Al	100	290	D	4500	1700	ND	1500	ND	6000	2200
Si	100	12000	45000	390	650	D	710	ND	640	800
Cr*	100	<200	<200	530	D	ND	D	ND	<500	<500
Mn*	100	ND	ND	ND	ND	ND	ND	ND	<50	<50
Fe	50	5300	1100	26000	12000	ND	12000	110	28000	12000
Rb*	100	9900	16000	1000	1300	1200	1300	1600		
Sr	5	320	92	2000	440	380	400	220	1900	430
Zr*	100	<300	<300	D	240	ND	220	ND		
Mo	100	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sb*	100	ND	ND	ND	ND	ND	ND	ND	<200	<200
Ba	5	57	ND	690	20	170	19	D	700	18

MDL= Method Detection Limit
D= Detected
ND= Not Detected

R. A. Torres
ICP-ES / ICP-MS*
Updated: 01-28-98

ng/gKDP		#147-seed-12
Z	MDL	
		7/23/97
		KDP
B	1000	ND
Na	300	ND
Mg	5	ND
Al	100	2200
Si	100	810
Cr*	100	<500
Mn*	100	<50
Fe	50	12000
Rb*	100	
Sr	5	440
Zr*	100	
Mo	100	ND
Sb*	100	<200
Ba	5	22

MDL= Method Detection Limit
D= Detected
ND= Not Detected

ng/gKDP		#8-2	#9-2	#163-5	#163-6	#163-7-ave	#163-8
Z	MDL	before #163	after #163				
		7/8/96	7/18/96	8/25/97	8/25/97	8/25/97	8/25/97
		KDP	KDP	KDP	KDP	KDP	KDP
B	1000	15000	29000	ND	ND	ND	ND
Na	300	75000	140000	ND	ND	ND	ND
Mg	5	80	150	ND	ND	D	D
Al	100	560	320	4100	4200	3100	2200
Si	100	13000	44000	430	410	510	710
Cr*	100	ND	ND	ND	ND	<500	<500
Mn*	100	ND	ND	ND	ND	<50	<50
Fe	50	1400	460	4600	5300	5600	4500
Rb*	100	9400	18000				
Sr	5	310	120	1800	1500	840	410
Zr*	100	ND	ND				
Mo	100	ND	ND	ND	ND	ND	D
Sb*	100	ND	ND	ND	ND	<200	<200
Ba	5	83	ND	780	510	140	39

MDL= Method Detection Limit
D= Detected
ND= Not Detected

R. A. Torres
ICP-ES / ICP-MS*
Updated: 09-21-98

ng/gKDP		#26-2	#27-2	#206-seed-4	#206-seed-7	#206-1-5	#206-1-8
Z	MDL	before #206	after #206				
		12/11/96	12/24/96	9/14/98	9/14/98	9/14/98	9/14/98
		KDP	KDP	KDP	KDP	KDP	KDP
B	300			ND	ND	ND	ND
Na	300	90000	160000	ND	ND	ND	ND
Mg	10	99	220	ND	ND	ND	ND
Al	100	290	310	1900	4700	1700	ND
Si	300	4200	42000	ND	ND	ND	ND
Cr	50	ND (200)	ND (200)	150	540	190	ND
Mn	10	ND (100)	ND (100)	ND	ND	ND	ND
Fe	20	480 (50)	130 (50)	1400	2200	1200	ND
Rb*	50	9800	17000				
Sr	10	280	100	360	1700	420	380
Zr	50	ND (300)	ND (300)	210	210	170	ND
Mo	50	950 (100)	1100 (100)	1700	400	720	ND
Sb*	20	ND (200)	ND (200)	ND (100)	ND (100)	ND (100)	ND (100)
Ba	10	150	ND	52	1700	170	600

MDL= Method Detection Limit
D= Detected
ND= Not Detected

R. A. Torres
ICP-ES / ICP-MS*
Updated: 08-27-97

ng/gKDP		#4-3	#5-3	#262-4A	#262-5	#262-cap-1	#262-cap-3
Z	MDL	before #262	after #262	KDP	KDP	KDP	KDP
		4/12/97	4/20/97	7/23/97	7/23/97	8/6/97	8/6/97
		KDP	KDP	KDP	KDP	KDP	KDP
B	1000	2400	5800	ND	ND	ND	ND
Na	300	5700	12000	D	D	D	D
Mg	5	25	62	ND	ND	16	ND
Al	100	950	340	7200	2400	D	ND
Si	100	3800	42000	480	720	300	250
Cr	200	D	ND	1400 (500)	<500	ND	ND
Mn	50	ND	ND	ND	ND	ND	ND
Fe	50	3200	370	15000	5700	D	ND
Rb*	100	4900	9700				
Sr	5	110	21	780	110	64	75
Zr	50	ND	ND				
Mo	100	ND	ND	ND	ND	ND	ND
Sb	200	4900	3500	8900	9300	1100	1000
Ba	5	180	ND	2700	25	24	25

MDL= Method Detection Limit
D= Detected
ND= Not Detected